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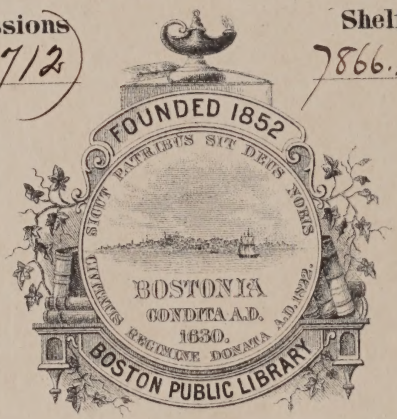

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From D.R.

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NOTES ON THE LITHOLOGY OF THE ISLAND OF JURA SCOTLAND.

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BY M. E. WADSWORTH.

This island, situated to the west of Scotland and south of the Firth of Lorn, according to Macculloch, Murchison, Geikie, and others, is composed of quartz rock and schists traversed by basaltic dikes running northeast and southwest. The quartz rock occupies most of the island particularly the western and central portions, while the schists predominate on the eastern coast. The quartz rock rises in the elevations known as the Paps of Jura to the height of 2569 feet, and dips, according to Macculloch, E .S .E., at an average angle of about 27°.

It is not my purpose to discuss the general geology of this island which is regarded as belonging to the Lower Silurian, for the reader will find sufficient information for ordinary purposes in the Transactions of the Geological Society of London, 1814 (1), II, 450–457; Macculloch's Western Islands of Scotland, 1819, II, 205–222; Geikie's Scenery and Geology of Scotland, 1865, pp, 214–218; Quarterly Journal of the Geological Society, 1861. XVII, 221, etc.

Several years ago there were placed in my hands a number of specimens of the Jura rocks by Mr. A. H. Wheeler of San Francisco, Cal., who had collected them. Descriptions were then written and given to him, and it is a revision of these descriptions that it is proposed to present to this Society to-night.

The main rock of the island, as before stated, is a quartzite, varying in texture from fine to coarse and forming in places a conglomerate. One specimen has a fine-grained gray groundmass of quartz grains holding larger rounded grains of milky, vitreous, and pink quartz. The rock closely resembles some of the indurated portions of the Potsdam sandstone of Wisconsin, and under the microscope it is seen to be composed principally of rounded quartz and feldspar grains. The cementing material is partly silica, but chiefly a material composed of minute greenish micaceous scales, apparently formed from the mud and feldspathic material of the rock. The feldspar grains of the original sandstone in the metamorphosis of this rock to quartzite, have been likewise more or less transformed into a mass of like greenish scales. Some feldspars, however, retain evidence of their triclinic nature. Besides these there also occur orthoclase and plagioclase grains that are as clear and transparent as the quartz, which from their general characters I am inclined to regard as secondary products in the rock, probably replacing some of the original feldspar grains. The quartz grains are as a rule well rounded showing prolonged attrition. This according to Sorby would indicate rather a wind-blown than a waterworn sand.[1] Surrounding the quartz grains between them and the matrix, are bands of exceedingly minute cavities appearing almost like black dust. These bands also exist in portions of the quartz and in the adjacent matrix and feldspars. They traverse the two latter without much regard for

[1] The Monthly Microscopical Journal, London, 1877, XVII, 113–136.

the micaceous scales, and from this it is probable that they are of later origin than the quartz grains, and were caused by the water action (hot?) which cemented the grains, altered the feldspars, and transformed the sandstone into a quartzite.[1] These cavities are apparently fluidal and sometimes have moving bubbles. Associated with these are larger fluid inclusions having rapidly moving bubbles. These latter inclusions are generally in the quartz and much resemble those seen in the quartz of granites, but they are not particularly abundant and may have a similar origin to those above mentioned. Indeed it would seem that if hot waters bearing silica in solution should deposit that silica in the minute fissures of the quartz it would produce the usual linear arrangement of cavities and bubbles, while the deposited silica would be so optically oriented that no trace of the "mending" process would be visible. Microlites, trichites, zircon, magnetite, etc., occur in the quartz. Some of the grains show the hair-like trichites so common in the quartz of granites. Some of the quartz appears to be of secondary origin, while part of the mica scales show the optical characters of muscovite.

The quartzite obtained at Red Cove is more compact, indurated, and of a more uniform character than the preceeding. It also contains trichites, secondary quartz, and fluid inclusions more abundantly. It has a slight reddish tinge owing to the iron oxides distributed through the section particularly in the decomposed feldspars.

No sections were made of the schists. One coming from the top of Cruib, near the center of the island, is a gray, fine-grained somewhat arenaceous rock. Another from the west side of the island is a bluish black argillaceous schist, almost an argillite, and contains cubes of pyrite. Schist like this is common in New England.

The only specimen, in the collection of the dikes, crossing the quartzites and schists is a dark gray rock with whitish and yellowish brown spots of decomposition products, opal, etc. The section is of a yellowish gray color, and under the microscope is seen to be composed of divergent ledge-formed feldspars, holding between them irregular grains and crystals of augite, olivine, and magnetite, while extending through most of the section is a dirty

[1] A. A. Julien, American Quarterly Microscopical Journal, January, 1879.

greenish viriditic product arising from the alteration of the various minerals of the rock and its presumed original base. There are also other secondary products which will be spoken of later. The feldspar as a rule shows the characters of basaltic plagioclase, but presents a whitish fibrous and granular alteration (kaolin) in places, as well as the viriditic product. The augite is cut by the plagioclase and has a reddish brown color. Its shades, owing to its dichroism, vary from a light brown to a yellowish brown. Its inclusions are principally magnetite and it is but little altered, the product in that case being generally viriditic.

The olivine is in irregular grains and crystals more or less fissured and altered. Some show mainly a clear olivine mass with little serpentinous alteration along the boundary and fissures, while others are entirely changed to serpentine pseudomorphs after the olivine. The serpentine is of a greenish, reddish brown, or orange-yellow color, the latter predominating. This is somewhat dichroic, the shade varying. The olivine shows the usual effect of the destructive action of the magma so commonly observed in the olivine of basalts. Some orthoclase occurs, but this appears to be entirely a secondary or alteration product in the rock. Many clear spots of transparent opal (hyalite) occur, while apatite needles are not uncommon.

The magnetite is in grains and crystals sometimes cut by the other minerals particularly the feldspar. It is also held in grains in the olivine as well as in the augite and feldspar. The general order of priority in the crystallization appears to be: magnetite, olivine, feldspar, augite, followed by the various secondary products.

This rock is regarded by me as having been originally identical with that forming modern basaltic dikes; the present difference being entirely owing to secondary changes brought about since the solidification of the rock. However in its present condition it would ordinarily be called a melaphyr, and closely resembles many of the melaphyrs of New England.

A boulder found on the east side of the island on the top of a hill at Lagg is a coarsely crystalline rock showing macroscopic hornblende, feldspar, biotite, and epidote.

Under the microscope it is seen to be composed of diallage, hornblende, feldspar, epidote, biotite, quartz, apatite, titaniferous iron, chlorite, etc. The diallage is of a colorless, yellowish, green-

ish, and reddish brown appearance. It remains only in remnants surrounded by the secondary hornblende. The cleavage is usually well marked although in one or two cases it is suggestive of the augitic variety. The hornblende is principally in needle-like fibers making up larger masses which optically have the same orientation. It is strongly pleochroic varying from a yellowish green to grass green and bluish green. The hornblende fibres extend out from the diallage through the adjacent feldspar and quartz in bundles and rods. The feldspar is chiefly triclinic, and is greatly altered, containing much epidote, chlorite, quartz, etc. The biotite shows dichroism from yellow to dark brown, occurs in masses and plates, not abundant, and generally is associated with the hornblende. The titaniferous iron is mainly altered to "leucoxene." The epidote is in nearly colorless granules scattered throughout the section, and in larger pale yellow masses, showing cleavage and twin structure. The quartz is in irregular masses in the feldspar and in the interspaces between the other minerals. It contains fluid cavities with moving bubbles and numerous granules, and needles of epidote, hornblende, etc. The apatite occurs in the usual elongated crystals, and is especially abundant in the chlorite. This mineral is in fibres and scales forming masses which sometimes show a dichroism varying from yellow to green, but at others are not dichroic. Some secondary feldspar was observed.

This rock I regard as once having possessed the characters of a gabbro or coarsely crystalline basalt (dolerite or diabase), but that it has since been subject to great alteration. So far as made out the feldspar, diallage (or augite), and titaniferous iron were the original minerals of the rock — if any olivine existed it has entirely disappeared — and that through their alteration by percolating waters (thermal?) has been produced the hornblende, chlorite, biotite, quartz, epidote, "leucoxene," the ferruginous products, and probably the apatite, etc.

In its present condition most lithologists would call this rock a quartz diorite, but I would prefer to class it under the species from which it appears to have been derived by alteration, that is under the basalts as a gabbro or diabase. This I would prefer in order to show its natural relations, since the term diorite now includes a great number of rocks produced by the alteration of different species running from basalt to granite.

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